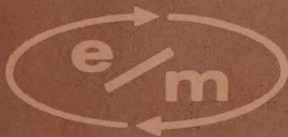


INSTRUCTION MANUAL

MODEL 86

VOLTAGE MONITOR

3042



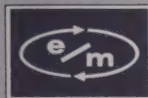
ELECTRONIC
MEASUREMENTS
COMPANY OF RED BANK
RED BANK NEW JERSEY



MODEL 86

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THE POWER SUPPLY RELIABILITY PROBLEM

It is a well known fact that in many situations the failure of a dc power supply can be a very costly event. For example, suppose a special life-run were being conducted on a group of 1,000 costly transistors. A failure of the power supply at some point midway in the run (such runs could involve anything from a few hundred to tens of thousands of hours) could result in the destruction of all the units under test, a loss of the potential information being developed, and a loss of all the time invested up to that point. Since the power supply is usually a much more complex device than the units under test, its failure before the end-life-point of all the elements under test is almost a certainty. Improvements in reliability are helpful but generally not a solution for two principal reasons. Firstly, an acceptable degree of reliability for a situation of this sort is difficult, if not impossible, to attain. It seems reasonable to state that an acceptable reliability figure would be orders of magnitude better than anything readily obtainable with available techniques and components. Secondly, as device-reliability is improved it is clear that a single unit will generally have a higher reliability than any group of devices assembled for a specific function.

Although the problem, when stated this way, appears to be unmanageable, there are ways of dealing with it. For example, if we redefine reliability as freedom from the occurrence of catastrophic events rather than freedom from the failure of any given element, we can then attain possible solutions.

One evident solution is to employ a continuous monitor to detect undesired events. The monitor must be as nearly fail-safe as possible, and the probability of failure of the monitor and the monitored device in such a manner as to defeat the original purpose must be virtually nil. Further, in the presence of an undesired event the monitor must prevent any damage to devices under test, and it must also provide failure alarm for operating personnel.

In considering ways of attaining the above solution the notion of redundancy enters the picture. Consider, for example, a monitoring system which employs a number of the components already in use in the power supply for other functions. Intuitively, one would surmise that there is a limit to the improvement in reliability which can be achieved in this fashion. There is also a limit to the types

of events which can be monitored. A much higher improvement in reliability (in terms of the redefinition of reliability given above) can be readily achieved by the use of completely separate components assembled to perform a specific function in as fail-safe a manner as possible. Of course, there are varying degrees of redundancy between the double use of components and unique employment. This will in general depend upon the needs of the situation, the means available to the designer, etc.

Model 86 Voltage Monitor is designed to implement the above ideas. It contains all of its circuitry and does not depend in any way on the power supply being monitored. It continuously monitors any given voltage within its range, permitting an excursion of the voltage within a certain band above and below the nominal voltage selected by the operator at the start. If the voltage exceeds the bandwidth at any time, the monitor issues a warning and initiates the protective action described below. Thereafter the system will remain in the idle position until the fault is cleared and the system restarted by the operator.

DESCRIPTION OF MODEL 86

Figure 1 is a simplified block diagram of the system. The monitored voltage is compared with a stable reference voltage through a resistance divider, the difference being fed to a detector amplifier. The output of the detector amplifier is connected to a bistable multivibrator (MVB). Normally, with the system in equilibrium (correct monitored voltage, etc.), the state of the MVB is such as to

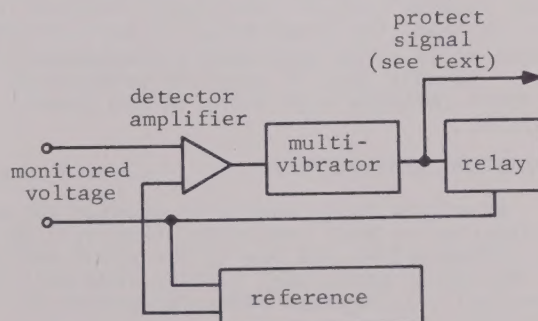


Figure 1. Model 86 Voltage Monitor, block diagram.

keep the relay in the energized position. When the monitored voltage departs sufficiently from its correct value the amplified error triggers the MVB to its second state, thus causing the relay to be de-energized. At the same time a protect signal is made available (see below). The relay (which is a power relay of the DPDT type) can be employed to initiate protective action, i.e. turn power off, actuate an alarm, etc. At this time a signal light on the front panel extinguishes to notify the operator. Thereafter, to bring the system back into operation, it is necessary to bring the monitored voltage back within the bandwidth permitted by the monitor, and press the reset button on the front panel of the monitor.

In some cases relay operation may not be sufficiently rapid to provide the desired degree of protection. For this reason a protect signal has been made available to provide electronic protection in one of the following forms:

- a. A transistor switch can be put in series with the monitored voltage. This switch would normally be fully on, but would be turned off by the protect signal in the presence of a fault. The operating speed available in this manner is of the order of 50 to 100 microseconds.
- b. The protect signal can be used to turn on a silicon controlled rectifier shunted across the output of the power supply. This would provide operating time of the order of 10 microseconds.

Using method b., there are some situations in which the rectifier would burn out. However even this would be tolerable in situations where thousands of hours and dollars are to be saved. It would merely be an expensive fuse. Of course in many cases matters can be arranged so that failure of the SCR is not necessary.

The design of this monitor is such that it can be included in existing power supplies with varying degrees of circuit redundancy. It can, for instance, be included in existing power supplies employing the internal reference bleeder system. The monitor can be readily equipped for programming in applications where it is to be used with a programmed voltage. In this case it requires programming resistors separate from those of the power supply.

OPERATING INSTRUCTIONS

Since the relay mode will provide suitable protection in most instances, this will be described below. If one of the other methods is employed, additional instructions will be required. To operate Model 86 proceed as follows:

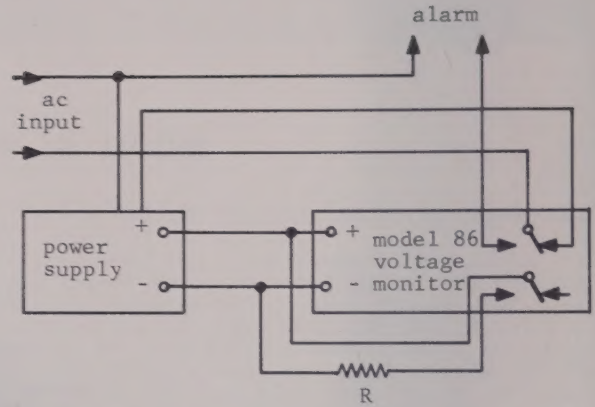


Figure 2. Model 86 Voltage Monitor, operating connections in relay mode. R= small resistance to bring voltage down rapidly.

- a. With all equipment turned off make connection as shown in figure 2.*
- b. Set the voltage control on the monitor to its maximum (clockwise) voltage position.
- c. Turn on the power supply and set to the desired voltage.
- d. Turn on the monitor ac input. The line indicator should glow. Select the desired bandwidth by operating the switch to A, B, C or D. (See specifications for descriptions of bandwidths.)
- e. Depress the RESET button and rotate the voltage dial counterclockwise to the region of the correct voltage. The correct point will be indicated by the click of the relay and the lighting of the NOR ON lamp.

Note: With the RESET depressed, the bandwidth is made very narrow to ensure finding of the middle of the voltage band; therefore the correct point will occupy only a small portion of the dial.

f. Although the bandwidth under this condition is less than one tenth of the narrowest voltage band, sometimes it may be desirable to find the center very accurately. To do this determine the point at which the relay drops out at either edge of the setting band, and then set to the center.

g. After finding the correct point and causing the NOR ON light to glow, release the button. The system will then be monitored as described above.

h. When it is desired to monitor programmed voltages it is necessary simultaneously to program the monitor to the correct voltages. The programming constant of the monitor is 200 ohms per volt. Other constants are available on order.

*This is only shown as a representative arrangement. Each user may have a particular variation. The two form C contacts on the relay may be employed in any manner consistent with ratings.

SPECIFICATIONS

VOLTAGE RANGE: 0-100 volts.

CALIBRATION ACCURACY: A ten turn dial is provided with a smallest division of .1 volt. The calibration accuracy is approximately .25% of full scale. The main functions of the calibrated dial is to indicate the correct region of operation.

VOLTAGE BANDWIDTH: Four bandwidths are provided plus a spare position for special values. At 100 volts the bandwidths are ± 1 , ± 2 , ± 3 and ± 5 volts. At voltages close to zero, the bandwidths are ± 70 , ± 140 , ± 210 and ± 350 millivolts. The bandwidth limits are within $\pm 20\%$ of the indicated values. The bandwidths for voltages between zero and 100 volts are indicated by the curves in figure 3, which is found on page 4 of this information sheet.

TEMPERATURE COEFFICIENT: The temperature coefficient of the monitor is approximately .05% per degree centigrade from 0° to $+45^{\circ}\text{C}$.

LINE VOLTAGE STABILITY: Line voltage variations have negligible effect upon the equilibrium voltage and operating characteristics of the monitor.

OPERATING SPEED: The operating speeds of the monitor are approximately as follows:

- Relay mode 20 milliseconds.
- Series switch mode 50-100 microseconds.
- Silicon controlled rectifier mode 10-20 microseconds.

PROVISION FOR EXTERNAL CIRCUITRY: A power relay with two form C contacts is normally incorporated. External connections are made on a barrier-type terminal strip at the rear. Relay contact rating 20 amperes ac at 115 volts.

POWER INPUT: All required dc potentials are internally supplied. The unit requires an input of 115 volts ac at 50-60 cps.

CONTROLS: LINE switch, VOLTAGE control, RESET control. The panel also contains a line indicator lamp and a NOR (normally) ON lamp which indicates the presence of the normal condition during monitoring.

CIRCUIT PROTECTION: Input ac line fused.

TERMINATIONS: Front (power supply connections) 5 way insulated binding posts. Rear (relay and protect signal terminals) barrier type terminal strips. Line cord is 3 conductor type.

MOUNTING: Unit is half rack type and is equipped with dimples for table mounting. Top and bottom are protected by perforated metal covers.

FINISH: Smooth gray semi-gloss enamel class 2 per MIL-E-15090.

DIMENSIONS: $3\frac{1}{2}$ inches high, $9\frac{1}{2}$ inches wide, $10\frac{1}{2}$ inches deep.

WEIGHT: 7 pounds approx.

(See page 4 for Figure 3.)

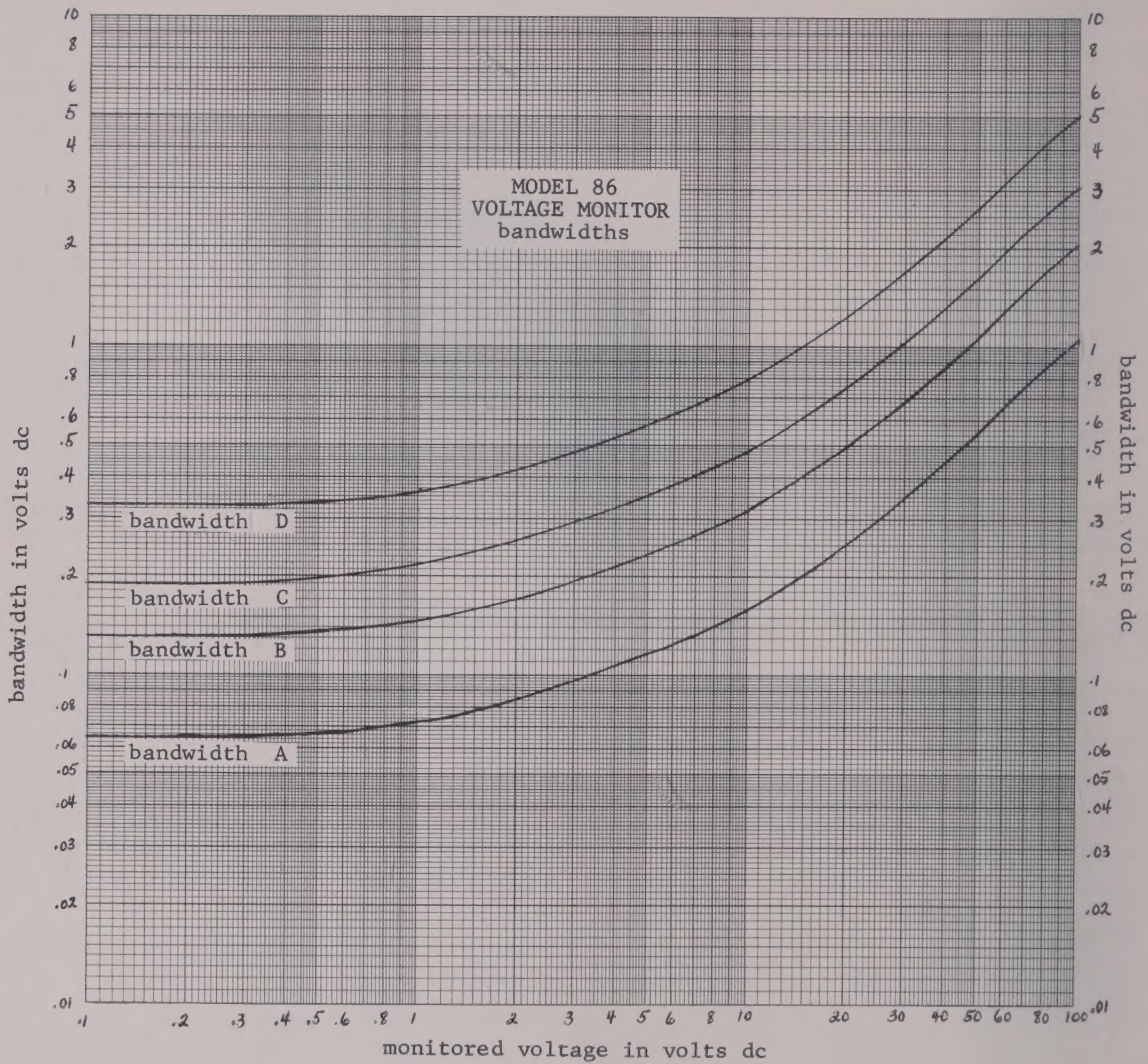


Figure 3. Model 86 Voltage Monitor, bandwidths A, B, C, and D versus monitored voltage.

